structural forum

Stop Knocking on Wood & Get Real

Become a Complete Structural Engineer

By Rakesh Gupta, Ph.D.

Did you know that 80 to 90 percent of all structures in the U.S. are wood structures? In Los Angeles County, 96 percent of all buildings are of wood-frame construction. In the U.S. and Canada, more wood, measured either by weight or by volume, is used in construction than all other construction materials combined. Given the predominance of wood as a building material, you may be astonished to learn that most Civil/Structural Engineering programs in the country do not even offer a course in wood design. In my opinion, a civil/structural engineer who is involved in any aspect of structural design is really an incomplete civil/structural engineer if he or she had no exposure to wood design in college.

I have personally witnessed this short coming when working with a few practicing structural engineers who were designing their first wood structures, yet had never formally studied wood design. This creates a dangerous situation because intelligent use of any material comes from "knowing the material." This is especially true for wood, which is the most complex building material compared to all other synthetic building materials. Wood is an organic material whose behavior and properties are governed by natural growth characteristics that cannot easily be controlled or modified.

"...intelligent use of any material comes from 'knowing the material'..."

Frank Lloyd Wright expressed it perfectly when he said, "We may use wood with intelligence only if we understand wood." Wood is nature's composite, and with the right combination of cellulose, hemicellulose, lignin, and extraneous materials formed in a cellular structure, it makes a near-perfect building material. It has been used for structures as long as humans can trace their history and even before, because wood was the only building material available (except stone/adobe). Its naturally high strength-to-weight ratio, natural durability, and sustainability make it an attractive choice for environmentally friendly construction material. Wood is hygroscopic, anisotropic (assumed orthotropic for practical applications), inhomogeneous, and inelastic. Its proper and efficient use depends on knowing its variable response to various physical and environmental loading conditions, and detailing all aspects of a structure in such a way that the structure responds to those loading conditions without overstressing its members and connections. Therefore, at least one course in wood behavior and design at the undergraduate level in all universities and colleges is essential for all civil/structural engineers, before they can be considered complete structural engineers.

Wood design education, which is taught primarily in departments of civil/structural engineering (CE/SE), is in crisis in colleges and universities in the U.S. and abroad (Canada, Australia, and Europe). In CE/SE programs in the U.S., the percentage of students required to take wood design has dropped from 14 percent in 1978 to 9 percent in 1994, and is definitely much lower today. A survey conducted in 2004 of basic education for structural engineers in colleges and universities demonstrated that about half of the respondents do not even offer a course in wood design (*STRUCTURE magazine*, July 2004). Overall, the number of colleges and universities offering a course in wood design is extremely low compared with the number of required non-wood material design courses. This is the main reason for the lack of familiarity with wood, compared with steel and concrete, among design professionals. This may also be the reason wood is not being used extensively in nonresidential construction in the U.S.

It is of critical importance that all students graduating with a degree in CE/SE be exposed to at least one course in wood behavior and design. This viewpoint also has been emphasized in recent articles by several practicing engineers while discussing basic course curriculum and contents for structural engineers (*STRUCTURE magazine*, December 2003 and February 2004). Wood design education is not only needed for the design of new structures, but is a must for practicing engineers involved in investigation and repair type projects where wood components are used. This special skill is more significant and necessary these days than ever before and will

1998 National Timber Bridge Design Competition Award Winning Bridge - First Place in Best Performance, Best Design, Most Aesthetic Design, and Most Innovative Design. Bridge Designed by FPS and ASCE Student Chapters of Oregon State University as a part of the Wood Design Course

be required in the future as well, especially since technological advances are introducing new engineered wood products in the market–which are increasingly being used with other non-wood materials to produce hybrid building systems.

If wood education is to survive at the university level, several actions must be taken:

(i) The engineering community and the wood products industry must recognize its importance, and pressure educational institutions to cover this subject matter in detail, at least at the undergraduate level. They also must put pressure on engineering accreditation boards to include wood education in CE/SE curriculums.

(ii) The wood products industry must step forward–with a united front–and begin to train educational staff, as the steel and concrete industries do. The industry must also make a range of teaching material available for instructors. Although several wood industry organizations offer numerous continuing education courses in wood design for practicing engineers, there is no coordinated or concerted effort by the industry to train future wood educators. This is in contrast to the steel and concrete industries, which offer summer institutes to university faculty in steel and concrete design. This may be one of the reasons that 80 percent of CE/SE programs continue to offer steel and concrete design as required courses.

(iii) Finally, the industry must fund research projects at universities so that faculty members can engage undergraduate students and inspire them to learn more about wood.

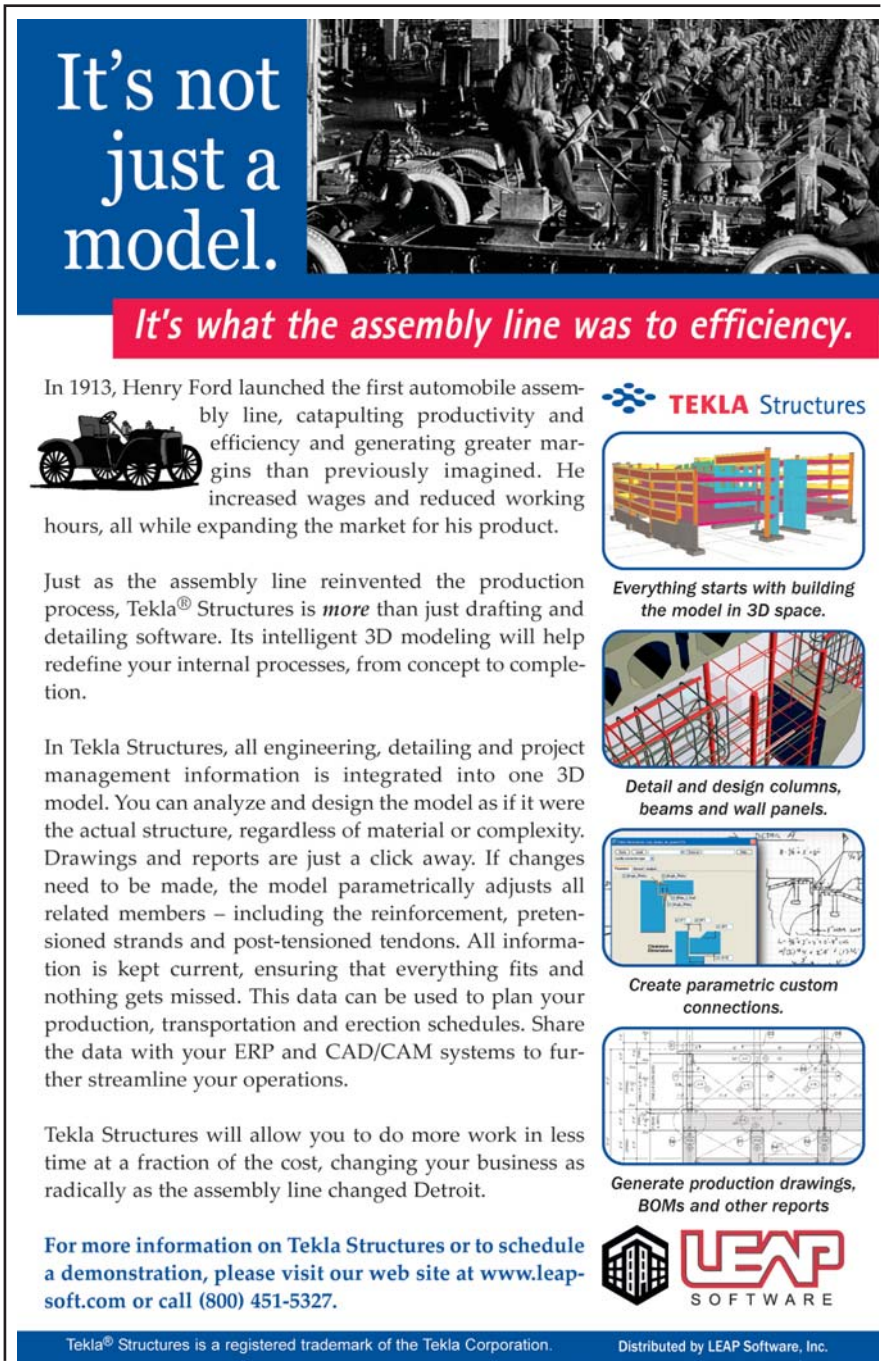
Another way for CE/SE students to learn wood design is to participate in National Timber Bridge Design Competition (**http://www.msrcd.org/bridge.htm**). The competition is endorsed by Structural Engineering Institute (ASCE/SEI). In my opinion, the competition provides students the only opportunity they will have in their entire professional lives to design, fabricate, and test a structure for its performance. I have used the Timber Bridge Competition as a class project in my Wood Design course at Oregon State University. Time and again, it has demonstrated that what is a beautiful/perfect design on a piece of paper may not always be constructed; and, even if it is constructed, it may not perform exactly as predicted by mathematical equations. It has taught students the idiosyncrasies of wood and much more.

In conclusion, wood design education at universities and colleges is already rare and is growing more so by the year. There is a definite need to reverse this trend so that design professionals feel comfortable designing with wood. The wood industry must take a proactive role in initiating and sustaining wood education at universities and colleges by:

- Helping all CE/SE programs to offer at least one course at the undergraduate level
- Sponsoring and supporting a yearly summer institute for university faculty to train them in teaching wood design courses in CE/SE programs,
- Developing and maintaining a teaching tool package containing a range of resources, and revising and upgrading it every 5 to 10 years, and
- Supporting wood-related research at universities to train future wood educators and researchers.

In closing, I would say that Civil/Structural Engineers may design with wood intelligently only if they are complete Civil/Structural Engineers by gaining exposure to wood behavior and design in college.▪

Rakesh Gupta, Ph.D., is an Associate Professor in the Department of Wood Science and Engineering at Oregon State University in Corvallis, Oregon. Rakesh currently serves as the Chair of the ASCE/SEI Committee on Wood Education and can be reached at ***rakesh.gupta@oregonstate.edu***



For Advertiser Information, visit www.structuremag.org